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SPECIFICATION FOR COLD-REDUCED AND HOT-ROLLED CARBON STEEL SHEET FOR PORCELAIN ENAMELLING

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SPECIFICATION FOR COLD-REDUCED AND HOT-ROLLED CARBON STEEL SHEET FOR PORCELAIN ENAMELLING

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Indian Standard

SPECIFICATION FOR COLD-REDUCED AND HOT-ROLLED CARBON STEEL SHEET FOR PORCELAIN ENAMELLING

0. FOREWORD

0.1 This Indian Standard was adopted by the Indian Standards Institution on 1 April 1980, after the draft finalized by the Wrought Steel Products Sectional Committee had been approved by the Structural and Metals Division Council.

0.2 This Indian Standard has been prepared with a view to guide the industry with regard to various requirements of carbon steel sheets for porcelain enamelling. In this standard three grades have been kept with different chemical compositions but without any distinction in the physical properties so as to help the consumers in selecting the composition depending upon the adherence requirements of the enamelling on the sheets rather than on physical strength.

0.3 For the purpose of deciding whether a particular requirement of this standard is complied with, the final value, observed or calculated, expressing the result of a test or analysis, shall be rounded off in accordance with IS : 2-1960*. The number of significant places retained in the rounded off value should be the same as that of the specified value in this standard.

1. SCOPE

1.1 This standard applies to cold-reduced and hot-rolled carbon steel sheet of commercial and drawing qualities for porcelain enamelling where surface of sheet and chemistry (Table 1) of the base metal are of prime importance.

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*Rules for rounding off numerical values (*revised*).

2. SUPPLY OF MATERIAL

2.1 General requirements relating to the supply of hot-rolled and cold-reduced carbon steel sheets shall conform to IS : 8910-1978*.

2.2 Hot-rolled carbon steel sheets shall be supplied either with mill edges or flattened and sheared edges while cold-reduced sheets shall be supplied in straight lengths or in coils.

3. GRADES

3.1 There shall be three grades of hot-rolled or cold-reduced carbon steel designated as A, B and C.

4. MANUFACTURE

4.1 Sheet shall be manufactured from steel made by the open-hearth, electric, duplex, basic oxygen or a combination of these processes. In case any other process is employed in the manufacture of steel by the manufacturer, prior approval of the purchaser should be obtained. If basic oxygen process is employed for manufacture, the nitrogen content of the steel shall not exceed 0·007 percent. This should be ensured by the manufacturer by occassional check analysis.

4.1.1 Steel may be supplied in killed, semi-killed or rimming quality with prior arrangement with the buyer.

5. CHEMICAL COMPOSITION

5.1 Ladle Analysis — Ladle analysis of the three grades of sheets, when analysed in accordance with the relevant part of IS : 228† shall be as given in Table 1.

5.2 Product Analysis — Permissible variation in case of product analysis from the limits specified in Table 1 shall be as given below:

Constituent	*Variation Over the Specified Maximum Limit, percent, Max*
Carbon	0·02
Sulphur	0·005
Phosphorus	0·005
Manganese	0·03

5.2.1 Check analysis shall not apply to rimming quality steel.

---

*General technical delivery requirements for steel and steel products.

†Methods of chemical analysis of steels (*second revision*) (being issued in parts).

TABLE 1 CHEMICAL COMPOSITION

(*Clauses* 1.1, 5.1 *and* 5.2)

GRADE	CONSTITUENT, PERCENT, *Max*				
	Carbon	Manganese	Sulphur	Phosphorus	Sulphur + Phosphorus
(1)	(2)	(3)	(4)	(5)	(6)
A	0·05	0·30	0·030	0·030	0·050
B	0·08	0·40	0·035	0·035	0·060
C	0·10	0·60	0·050	0·050	0·090

NOTE 1 — Other elements like Ti, Cb, etc, may be used for stabilization of carbon by mutual agreement.

NOTE 2 — If steel is silicon killed, silicon limits should be 0·15 to 0·35 percent. If steel is Al or Al-Si killed minimum silicon specified shall not be applicable.

6. BEND TEST

6.1 Bend Test (when Specified) — One representative sample for the bend test shall be taken from each lot of 10 tonnes or part thereof or per coil. A lot consists of all sheet of the same quality rolled to the same thickness and condition.

6.1.1 Where sheet and strip of more than one thickness are rolled from the same cast, one additional bend test shall be made for each thickness of sheet.

6.2 Bend test shall be carried out in accordance with IS : 1692-1974*.

6.2.1 Bend test pieces shall be cut so that the axis of the bend is parallel to the direction of rolling, that is the longer axis of the test piece shall be at 90°C to the direction of rolling.

6.2.2 The test pieces shall be bent cold through 180°. The internal diameter of the bend for the different grades of material shall be equal to its thickness.

7. CUPPING TEST

7.0 The test is applicable only for cold rolled sheets of drawing quality.

7.1 One cupping test shall be carried out from each lot of 10 tonnes of material or part thereof from each cast. In case of coils, one Erichsen cupping test shall be carried out on each coil.

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*Method for simple bend testing of steel sheet and strip less than 3 mm thick (*first revision*).

7.1.1 Where sheets of more than one thickness are rolled from the same cast, one additional cupping test shall be made for each thickness of sheets.

7.2 Cupping test shall be carried out in accordance with IS : 1756-1974*, and the minimum Erichsen values shall be as given in Fig. 1.

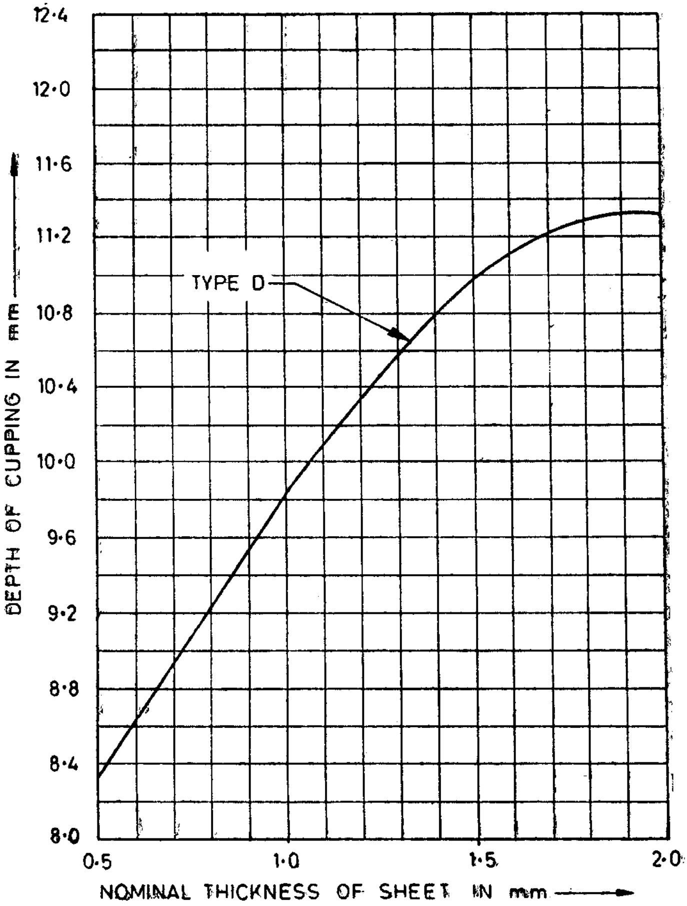

FIG. 1 MINIMUM ERICHSEN VALUES

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*Method for modified Erichsen cupping test for steel sheet and strip (*first revision*).

8. STRAIN-AGE EMBRITTLEMENT TEST

8.1 Strain-age embrittlement test is applicable only to sheets of drawing quality and shall be carried out only by agreement between the manufacturer and the purchaser.

8.2 The method of carrying out the test shall be as specified in **8.2.1** to **8.2.4**.

8.2.1 The test piece, 75 mm long and 25 mm wide, shall be cut so that the longer axis is at right angle to the direction of rolling. The edges of the test piece may be rounded and smoothed longitudinally to an approximately semicircular contour.

8.2.2 The test piece shall be bent cold through 90° round a former having its diameter equal to three times its thickness. The axis of the bend shall be parallel to the direction of rolling.

8.2.3 The test piece shall then be heated to 250 ± 5°C and maintained at that temperature for 15 minutes and then cooled in still air to room temperature.

8.2.4 The test piece, when straightened by hammer blows on the apex of the bend, shall flatten without cracking.

9. RETESTS

9.1 Should any of the test pieces first selected fail to pass any of the tests specified in this standard, two further samples shall be selected from the same lot for testing in respect of each failure. Should the test pieces from both the additional samples pass, the material represented by the test samples shall be deemed to comply with the requirements of that particular test. Should the test pieces from each of these additional samples fail, the material represented by the test samples shall be deemed as not conforming to this standard.

10. SURFACE FINISH

10.1 Hot-Rolled — Hot-rolled sheets should be free from harmful defects and may be supplied in as rolled condition, annealed, pickled and oiled by mutual agreement.

10.1.1 In case steel sheets are to be supplied free from coil breaks and waviness, in accordance with the purchaser's requirements, they shall be skin passed.

10.2 Cold Rolled — The finished sheets shall be free from harmful defects, such as scale, rust, blister, laminations, pitting, cracked edges and other imperfections that are detrimental to subsequent appropriate processing.

10.2.1 Unless otherwise specified, the sheet shall have a matte (dull) finish suitable for porcelain enamelling.

10.2.2 The sheet shall be reasonably flat and the edges clearly sheared and truly squared to the specified dimensions.

11. DIMENSIONS

11.1 Standard dimensions of hot-rolled and cold-rolled sheets shall be as agreed to between the purchaser and the manufacturer.

12. ROLLING TOLERANCES

12.1 Tolerances on thickness, width, length and mass of steel sheets shall conform respectively to the tolerances given in Table 2 to 5.

TABLE 2 TOLERANCE ON THICKNESS

All dimensions in millimetres.

Thickness of Sheet	Permissible Tolerance	
	Hot Rolled	Cold Rolled
(1)	(2)	(3)
0·32	As specified in IS : 1852-1973*	± 0·04
0·40		± 0·05
0·50		± 0·06
0·63	—	± 0·07
0·80	—	± 0·08
0·90	—	± 0·09
1·00	—	± 0·10
1·12	—	± 0·11
1·25	—	± 0·12
1·40	—	± 0·13
1·60	—	± 0·14
1·80	—	± 0·15
2·00	—	± 0·16
2·24	—	—
2·50	—	—

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*Rolling and cutting tolerances for hot-rolled steel products (*second revision*).

TABLE 3 TOLERANCE ON WIDTH AND LENGTH

(*Clause* 12.1)

All dimensions in millimetres.

WIDTH	TOLERANCE, TOTAL MARGIN		LENGTH FOR SHEET SUPPLIED IN STRAIGHT LENGTH	TOLERANCE	
	Hot Rolled	Cold Rolled		Hot Rolled	Cold Rolled
(1)	(2)	(3)	(4)	(5)	(6)
Up to 1 000	+6	+6	Up to 2 500	+25	+15
Above 1 000	0·75 percent	0·6 percent	Over 2 500	+1·0 percent	0·75 percent

TABLE 4 TOLERANCE ON MASS

(*Clause* 12.1)

RANGE	PERMISSIBLE TOLERANCE	
	Hot Rolled	Cold Rolled
(1)	(2)	(3)
Single sheet	±8 percent	±7·0 percent
Bundles of 2 tonnes	±7 percent	±5·0 percent

12.1.1 In case of coils, the variation in width from the specified value shall not be more than $\begin{matrix}-0 \text{ mm}\\ +30 \text{ mm.}\end{matrix}$

12.2 Edge Camber — The edge camber (that is, the lateral departure of the edge of the material from a straight line forming a chord) of hot-rolled and cold-rolled steel (including descaled) sheets in cut lengths and coils shall not exceed the tolerance given below.

Form	*Tolerance, Max*	
	Hot rolled	Cold rolled
Cut length	0·5 percent × length	0·4 percent × length
Coils	25 mm in any 5 000 mm length	20 mm in any 5 000 mm length

12.3 Out-of Square Tolerances — The out-of square tolerance for sheets of all gauges and all sizes shall be 1·0 percent of the width.

12.4 Flatness Tolerances — When the sheets are required to be supplied in the flattened condition, either by roller or stretcher levelling, the permissible maximum flatness tolerance (*see* Fig. 2) shall be as given in Table 5.

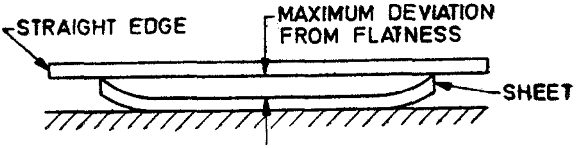

FIG. 2 FLATNESS TOLERANCE

TABLE 5 FLATNESS TOLERANCE SHEET FOR HOT ROLLED AND COLD REDUCED STEELS, CUT LENGTHS

(*Clause* 12.4)

All dimensions in millimetres.

WIDTH	HOT ROLLED		COLD REDUCED	
	Thickness	Flatness Tolerance	Thickness	Flatness Tolerance
(1)	(2)	(3)	(4)	(5)
Up to and including 1 200	Up to and including 2	18	Up to and including 0·7	15
Over 1 200 up to and including 1 500	do	25	do	18
Over 1 500	do	30	do	22
Up to and including 1 200	—	—	Over 0·7 up to and including 1·2	12
Over 1 200 up to and including 1 500	—	—	do	15
Over 1 500	—	—	do	19
Up to and including 1 200	Over 2	15	Over 1·2	10
Over 1 200 up to and including 1 500	do	20	do	12
Over 1 500	do	25	do	17

13. BUNDLING AND PACKING

13.1 Sheets shall be supplied in bundles or in packages each weighing up to 12·5 tonnes (for hot-rolled) and 3 tonnes (for cold-rolled) as may be agreed to between the purchaser and the manufacturer.

13.2 Sheets shall be securely packed in waterproof paper or hessian cloth and securely tied round with hoop iron and with wooden battens underneath to prevent the sheets from rusting and damage during transit.

14. MARKING

14.1 Every bundle or package of sheet shall be legibly marked with the following:

a) Name or trade-mark of the manufacturer,
b) Type,
c) Finish, and
d) The cast or identification mark, by which the sheets can be traced to the cast or casts from which they were made.

14.1.1 The material may also be marked with the ISI Certification Mark.

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